

## PATENT COOPERATION TREATY

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## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference FT-227PCT	<b>FOR FURTHER ACTION</b> See Form PCT/PEA/416	
International application No. PCT/JP2005/002683	International filing date (day/month/year) 15.02.2005	Priority date (day/month/year) 19.02.2004
International Patent Classification (IPC) or national classification and IPC INV. H01M8/06 C01B3/34 C01B3/36 C01B3/48 H01M8/04		
Applicant TOYOTA JIDOSHA KABUSHIKI KAISHA et al.		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input type="checkbox"/> sent to the applicant and to the International Bureau a total of sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the report</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand  08.12.2005	Date of completion of this report  16.06.2006	
Name and mailing address of the International preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Haering, C  Telephone No. +49 89 2399-8010 	

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/JP2005/002683

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on
- ☒ the international application in the language in which it was filed
  - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of:
    - ☐ international search (under Rules 12.3(a) and 23.1(b))
    - ☐ publication of the international application (under Rule 12.4(a))
    - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a))
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-47 as originally filed

**Claims, Numbers**

1-10 as originally filed

**Drawings, Sheets**

1/7-7/7 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing *(specify)*:
  - ☐ any table(s) related to sequence listing *(specify)*:
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing *(specify)*:
  - ☐ any table(s) related to sequence listing *(specify)*:

\* If item 4 applies, some or all of these sheets may be marked "superseded."

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	1-10
	No: Claims	
Inventive step (IS)	Yes: Claims	1-10
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-10
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

**1. Disclosures:**

- D1: EP-A-0 973 220 (TOYOTA JIDOSHA KABUSHIKI KAISHA) 19 January 2000  
D2: WO 99/44252 A (HYDROGEN BURNER TECHNOLOGY, INC) 2 September 1999  
D3: EP-A-1 148 024 (DAIKIN INDUSTRIES, LTD) 24 October 2001 (2001-10-24)  
D4: EP-A-1 233 468 (DELPHI TECHNOLOGIES, INC) 21 August 2002 (2002-08-21)  
D5: US 2001/028966 A1 (KNIGHTS SHANNA D ET AL) 11 October 2001  
D6: PATENT ABSTRACTS OF JAPAN vol. 016, no. 401 (E-1253), 25 August 1992 & JP 04 133271 A (NIPPON TELEGR & TELEPH CORP <NTT>), 7 May 1992  
D7: PATENT ABSTRACTS OF JAPAN vol. 2000, no. 10, 17 November 2000 (2000-11-17) & JP 2000 195534 A (TOYOTA MOTOR CORP), 14 July 2000
- 1.1. Document D1 discloses a fuel cell system, and the method for controlling it, comprising a reformer, a fuel cell, a fuel pump with controlling valve, a cathode pump with controlling valve a controlling device which controls the valves and the generated power quantity. Further the device can determine an amount of heat fuel and an amount of the oxidiser, based on the amount of reforming reaction requirement and a desired **ratio between the amount of heat fuel and the amount of the oxidiser**. **The cathode offgas is not taken into account at all.**
- 1.2. Document D2 discloses a controlling method of a fuel cell system similar to D1.
- 1.3. Document D3 relates to a technique for adjusting quantity of water vapour and oxygen in the cathode offgas by controlling quantity of electricity generation of the fuel cell. **There is no description that a residual oxygen quantity in the cathode offgas is detected and a reformed carbon quantity is controlled.**
- 1.3. Document D4 simply discloses a method for controlling a fuel cell system wherein the **amounts of fuel oxidant and water feeding the reformer are regulated** (their ratio are kept in a target range), depending on the desired voltage output.
- 1.4. Documents D5 and D6 disclose a fuel cell system, and the method for controlling it, comprising a reformer, a fuel cell, a fuel and a cathode pumps with controlling valves, a controlling device, wherein **the carbon quantity C (fuel) and the oxygen quantity O (from the air) needed for reforming are measured**, and the O/C ratio is determined

and kept in a target range, depending on the power generated.

- 1.5. Document D7 is defining the general state of the art which is not considered to be of particular relevance.

**2. *Novelty and inventive step:***

- 2.1. None of the documents has considered the use of cathode offgas to feed the reformer, wherein:
- a. the oxygen quantity, supplied to the cathode, and the oxygen quantity, consumed in the cathode, are detected in order to calculate the residual oxygen quantity (difference of both), which is then supplied to the reformer (reformed oxygen quantity)
  - b. the reformed carbon quantity supplied to the reformer is calculated, based on the supplied fuel quantity,
  - c. the ratio reformed oxygen / reformed carbon is determined and corrected, kept in a target range, by varying the delivery of fuel from the fuel pump.

Thus, the subject-matter of claim 1 is considered as new regarding the cited prior art documents (Article 33(2) PCT).

- 2.2. The problem to be solved by the present invention may be regarded as adjusting the reformed hydrogen quantity needed by said the fuel cell, depending on its efficiency, and thus optimising said efficiency.

- 2.3. By the method of claim 1, the residual oxygen from cathode offgas is reflowed into the reformer, and the amount of fuel fed to the reformer is adapted, depending on the oxygen amount of said residual flow (by determining a O/C ratio, and maintaining it in a target range), so that the optimum amount of reformed hydrogen needed by the fuel cell is delivered to it.

The reforming process, and the quantity of fuel needed by the fuel cell to generate the requested power, are thus directly adapted to the oxygen consumption of said fuel cell, by taking the residual oxygen amount in cathode offgas into account, i.e. feedback from fuel cell efficiency.

- 2.4. None of the cited document has considered such a feedback optimisation process of fuel cell system.

Thus, the solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT)

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(SEPARATE SHEET)**

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2.5. Claims 2 to 8 and 10 are dependent on claims 1 and 9 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

**3. *Clarity:***

**(Certain observations on the international application)**

Typing error on fig. 2 step SO4